ACUTE TOXICITY SUMMARY

PERCHLOROETHYLENE

(ethylene tetrachloride, tetrachloroethylene)

CAS Registry Number: 127-18-4

I. Acute Toxicity Summary (for a 1-hour exposure)

Inhalation reference exposure level	**20 mg/m^3**
Critical effect(s)	loss of normal coordination in addition to eye, nose and throat irritation, headache and light-headedness
Hazard Index target(s)	nervous system; eyes; respiratory system

II. Physical and Chemical Properties (HSDB, 1993 except as noted)

Description	colorless liquid
Molecular formula	C_2Cl_4
Molecular weight	165.83
Density	1.6227 g/cm^3 @ 20°C
Boiling point	121°C
Melting point	-19°C
Vapor pressure	18.47 mm Hg @ 25°C
Flashpoint	unknown
Explosive limits	unknown
Solubility	soluble in alcohol, ether, chloroform, benzene and hexane; practically insoluble in water
Odor threshold	47 ppm (geometric mean) (AIHA, 1989)
Odor description	colorless, mildly sweet, chloroform-like odor
Metabolites	trichloroacetic acid, trichloroethanol (ATSDR, 1992)
Conversion factor	1 ppm = 6.78 mg/m^3 @ 25°C

III. Major Uses or Sources

Perchloroethylene (PCE) is widely used in the textile industry for dry-cleaning, processing, and finishing fabrics (HSDB, 1993). It is also used in the degreasing of metals and as a chemical intermediate in the synthesis of fluorocarbons. Electric transformers contain PCE as an insulating fluid and cooling gas.

IV. Acute Toxicity to Humans

PCE is an eye, skin, and respiratory irritant. The most sensitive endpoint of PCE toxicity is the central nervous system (Calabrese and Kenyon, 1991). Cardiac sensitization and arrhythmias

have been reported following acute exposure to high concentrations of PCE (Reprotext, 1999). In one case report, pulmonary edema and coma followed a single exposure to an unknown concentration of PCE (Patel *et al*., 1977). Hepatic necrosis and renal failure have been observed following inhalation exposure (Gosselin *et al*., 1984). Symptoms associated with acute exposure to lower levels of PCE include tiredness, weakness, and nausea and vomiting (Reichert, 1983).

Four human volunteers exposed to 206-235 ppm (1,400-1,600 mg/m³) PCE for 2 hours acclimatized to the odor within minutes (Rowe *et al*., 1952). All subjects reported eye irritation and congestion of the frontal sinuses after 20-30 minutes of exposure. Two of the four test subjects experienced dizziness. A separate group of 4 subjects exposed to 280 ppm (1,900 mg/m³) PCE for 2 hours reported light headedness and one subject reported nausea.

Human subjects exposed to 100 ppm (700 mg/m³) PCE for 7 hours exhibited CNS effects as indicated by an abnormal modified Romberg test (a test of position sense) and symptoms including headache and light-headedness (Stewart *et al*., 1970). Symptoms were noted after the first 3 hours of exposure. Subjects exposed for 7 hours per day for 5 days reported decreased odor perception of PCE over the course of each exposure.

Mild and transient hepatitis was diagnosed in a worker found unconscious following a 30-minute exposure to an unknown concentration of PCE (Stewart, 1969). Elevated serum enzymes, which indicate impaired liver function, were observed in a worker rendered semicomatose by exposure to unknown levels of PCE for 3 hours (Stewart *et al*., 1961). A simulation of the exposure conditions in the latter case report indicated that the average estimated concentration was at least 275 ppm (1,900 mg/m³) PCE.

Predisposing Conditions for Perchloroethylene Toxicity

Medical: Persons with preexisting skin, eye, respiratory, heart, liver, kidney, skin, or neurolgical conditions may be more sensitive to the effects of PCE exposure (Reprotext, 1999). Individuals with hypertension may be at increased risk of exhibiting elevated blood pressure following exposure to PCE.

Chemical: Interactions between PCE and trichloroethylene and ethyl alcohol, resulting in a potentiation of toxicity, have been reported (Reprotext, 1999).

V. Acute Toxicity to Laboratory Animals

The LC_{50} for a 4-hour exposure to PCE is reported to be 5,200 ppm (35,000 mg/m³) in mice (Friberg *et al*., 1953) and 4,000 ppm (27,000 mg/m³) in rats (Carpenter *et al*., 1949). Rats exposed to 2,300 ppm (16,000 mg/m³) PCE for 4 hours exhibited ataxia and signs similar to those of ethanol intoxication (Goldberg *et al*., 1964).

Enlarged livers were observed at necropsy in mice exposed continuously to 9, 37, 75, or 150 ppm (60, 250, 510, 1,000 mg/m³) PCE for 30 days (Kjellstrand *et al*., 1984). Enlargement and

vacuolization of hepatocytes were most pronounced in the mice exposed to 150 ppm PCE. In a separate study, hepatocellular vacuolization was observed in mice at necropsy following a single 4-hour exposure to 200 ppm (1,400 mg/m^3) PCE (Kylin *et al*., 1963).

Mice exposed for a single 3-hour period to 50 ppm (340 mg/m^3) PCE exhibited a significant decrease in pulmonary bactericidal activity (type unspecified) (Aranyi *et al*., 1986). No significant changes were observed in pulmonary bactericidal activity and mortality in mice exposed to 25 ppm (170 mg/m^3) PCE for a single 3-hour exposure or for five 3-hour exposures. Mortality was significantly increased in mice exposed to 50 ppm PCE and challenged with aerosolized streptococci when compared to controls.

VI. Reproductive or Developmental Toxicity

A single case-control study among women employed in dry cleaning operations indicates an increased risk of spontaneous abortion resulting from PCE exposure (Kyyronen *et al*., 1989). However, this study is seriously limited by the small number of exposed women (247) and the lack of biological monitoring during the first trimester. No studies evaluating the reproductive performance of occupationally exposed men were located.

Pregnant mice exposed to 300 ppm (2,000 mg/m^3) PCE for 7 hours per day on gestation days 6-15 exhibited increased fetal resorptions and other signs of fetotoxicity including decreased fetal body weight and delayed ossification of skull bones and sternebrae (Schwetz *et al*., 1975). Pregnant rats similarly exposed on gestation days 6-15 exhibited a slight decrease in weight gain, but no statistically significant signs of fetotoxicity.

Male guinea pigs exposed to 1,600 ppm (11,000 mg/m^3) PCE for 7 hours per day for 8 exposures over a 10 day period exhibited degenerative changes in the germinal epithelium of the testes (Rowe *et al*., 1952).

VII. Derivation of Acute Reference Exposure Level and Other Severity Levels (for a 1-hour exposure)

Reference Exposure Level (protective against mild adverse effects): 20 mg/m^3 (2.9 ppm)

Study	Stewart *et al*., 1970
Study population	three human subjects
Exposure method	inhalation of 100 ppm (700 mg/m^3) PCE
Critical effects	CNS effects as indicated by an abnormal modified Romberg test and symptoms including headache, mild irritation of the eyes, nose and throat, and light-headedness
LOAEL	700 mg/m^3
NOAEL	not observed
Exposure duration	3 h
Extrapolated 1 hour concentration	1200 mg/m^3 (700^2mg/m^3* 3 h = C^2 * 1 h)

	(see Table 12 for information on "n")
LOAEL uncertainty factor	6
Interspecies uncertainty factor	1
Intraspecies uncertainty factor	10
Cumulative uncertainty factor	60
Reference Exposure Level	20 mg/m^3 (20,000 μg/m^3; 2.9 ppm)

Level Protective Against Severe Adverse Effects

No recommendation is made due to the limitations of the database.

Level Protective Against Life-threatening Effects

No recommendation is made due to the limitations of the database.

NIOSH (1995) reports an IDLH of 150 ppm (1,017 mg/m^3) based on acute inhalation toxicity data in humans but the level does not appear to be life-threatening based on the data cited.

VIII. References

(ATSDR) Agency for Toxic Substances and Disease Registry. Toxicological profile for tetrachloroethylene. Prepared by Clement International Corporation, under contract No. 205-88-0608 for US Department of Health and Human Services, Public Health Service, ATSDR; 1992.

(AIHA) American Industrial Hygiene Association. Odor threshold for chemicals with established occupational health standards Akron (OH): AIHA; 1989. p. 26.

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